-11/C 343(rev 1)

JUL 9 1979
FISH & WILDLIFE SERVICE

THE POTENTIAL OF THE FISHERIES TO PROVIDE INCREASED FOOD SUPPLIES FOR THE DEVELOPING COUNTRIES AND THE REQUIREMENTS FOR INVESTMENT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, April 1977

W/K5414

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The copyright of this document is vested in the Food and Agriculture Organization of the United Nations. The document may not be reproduced, in whole or in part, by any method or process, without written permission from the copyright holder. Applications for such permission, with a statement of the purpose and extent of the reproduction desired, should be addressed to the Director, Publications Division, Food and Agriculture Organization of the United Nations, Via delle Terme di Caracalla, 0100 Rome, Italy

FAO 1977

Abstract

The potential sustainable yield of world fisheries is estimated to range from 240 to more than 455 million tons a year. This paper deals broadly with the requirements in funds and other inputs to exploit this potential to the extent, as a start, of 130 million tons a year. The investment required to achieve this target in 20 years (1980-2000) is estimated to be about U.S.$ 30 000 million, excluding preparatory and pre-investment and some other costs.

As the paper points out, the required technology and all the necessary inputs are mostly available. What is needed is the resolve of governments - especially those of the developing countries - to adopt the policies and programmes essential for the exploitation of the rich potential of fisheries. Given this initiative and determination by the governments, fisheries can become a major source of supply of animal protein food for mankind.

It should be noted that the potential sustainable yield ranging from 240 million tons to more than 455 million tons, as quoted in this document, includes both conventional and non-conventional species as shown in table 1.

FAO Fisheries Circular (FAO Fish.Circ.)

A vehicle for distribution of short or ephemeral notes, lists, etc., including provisional versions of documents to be issued later in other series.

Digitized by the Internet Archive
in 2025

https://archive.org/details/fao-fisheries-and-aquaculture-circular_1977-04_343-revision-1

TABLE OF CONTENTS

		Page
1.	INTRODUCTION	1
2.	THE PRESENT SITUATION AND POTENTIAL RESOURCES	1
3.	TRADE AND MARKETS	6
4.	INVESTMENT ASPECTS	7
5.	PRE-INVESTMENT ACTION REQUIRED	12
6.	ESTIMATED INVESTMENT REQUIREMENTS	13
7.	CONCLUSIONS	16

Table 1 - Present Utilization ond Potential of Fishery Resources 18

Table 2 - Fisheries Sector: Estimated Official Development Assistance, 1974 19

Table 3 - First Cost (1976) and Production Performance of Various Vessel Types 19

Table 4 - Assumptions Regarding Costs of Shore Installations 20

Table 5 - Estimated Investment Required to Increase Fish Production to 130 million t/year, 1976 prices 21

Table 6 - Estimated Capital Investment (1976 prices) to Meet Requirements for Increased Production related to Various Levels of Demand, excluding Development Costs and Costs of Distribution Systems; including Costs of Training Key Manpower 21

1. INTRODUCTION

In the protracted battle to increase food supplies for the needy millions of people in the world, mostly living in the developing countries, there is a danger of overlooking the potential of a major food resource - fisheries. Contrary to a commonly held, but unjustified, belief that the exploitation of food-source fisheries is near to the limit, the truth is that the world harvest from fisheries could be at least doubled in the next two decades. Indeed, estimates of the potential harvest range from 240 to 455 million tons or more per year - a far cry from the present world catch of some 70 million tons a year.

The purpose of this paper is to draw the attention of governments to the need to exploit this potential supply of fish and other aquatic life so as to make available more millions of tons of food which is especially rich in animal protein - the quality most needed by those masses of people who are under-nourished.

How much of the huge potential is to be harvested depends largely on the response of governments to the challenge and opportunity. As this paper indicates, a reasonable target to aim at, based on projected world population growth and purchasing power, would be a catch of 130 million tons a year by 2000 - almost twice as much as the total catch today. It is estimated that an investment of some U.S.$ 30 000 million between 1980 and 2000 would be required to reach this target - an imput rate of U.S.$ 1 500 million a year for 20 years.

Of course, investment alone cannot bring about the increased production envisaged. Constructive fishery policies by governments, with supporting action in legislation, infrastructure, industry, training and so on, are all required to ensure success. These and other requirements are discussed in this paper and suggestions are made as to the pre-investment actions needed to be taken as well as those required for the long-term success of the investment effort.

The present catch of fisheries is far higher than was thought probable 20 years ago, based on the knowledge then of the world's aquatic resources. The growth of knowledge of the resources has been rapid in recent years, hence the new evaluation of the potential world catch. As this paper shows in presenting the current view of the resources situation and the opportunity to harvest the many millions of tons of extra food available, fisheries have a significant role to play as a food supplier to the future world. The technology to achieve success is generally available and the other required inputs can be found and provided. The need now is the determination of governments to exploit the potential available to them.

2. THE PRESENT SITUATION AND POTENTIAL RESOURCES

As already stated, the estimates of the potential yield of the oceans and other waters have increased substantially in recent decades. The increased knowledge of resources and the improved catching power of the fishing industry have resulted in the present catch being three times as much as it was in 1950. While much of the increased catch has been used for industrial purposes, the direct consumption of fish as food has also increased from about 7.2 kg per caput in 1950 to about 12.5 kg in 1974-75, on a global basis. Thus, fisheries now provide a substantial proportion of the animal protein content in man's diet - estimated to be as much as 19 percent in developing countries.

The forward march of fisheries production has not, however, been uninterrupted. For example, the partial collapse of the anchoveta fishery off Peru and Chile was a serious setback. The catch from this fishery had grown in 20 years to some 12 million tons per annum, but in 1971 it dropped to 4 million tons. That 8 million tons deficit, however, was made up through increased production of other fisheries, thus maintaining the world total at about 70 million tons. Conservation measures are helping the anchoveta fishery to recover but the average yearly yield in the long term is likely to be less than the high yield of 12 million tons.

Other stocks of popular species of fish have also declined in yield due to being exploited at or beyond their sustainable yield. The situation has clearly shown the need for more effective control measures to maintain them at their optimum yield level. Even so, contrary to the impression often held by the public, the limiting factor in production is not the fishery resources. These, as reference to Table 1 will show, are estimated to be sufficient to provide for a world total catch of 240 to 455 million tons a year.

Apart from the resource situation, other factors have limited the catch in recent years. These include the increasing cost of fishing, such as the rising price of fuel, supplies and equipment and the increase in wages. The economic recession has also discouraged re-investment and, at the same time, has hastened the scrapping of the older and less efficient vessels. The uncertainty about the consequences of the extension of national fishing limits has also resulted in owners of long-distance vessels postponing the construction of new ships. However, looked at from the present time and judging from past experience, it seems reasonable to suppose that the fishing industry will have its share of upsurge with the revival of the world economy and that it will soon adjust to the new fishing limits situation. This adjustment may eventually be of benefit both to the industry and to those coastal states which seek foreign collaboration in the exploitation of their fisheries and the development of their fishing industry ashore and afloat.

Table 1, of course, shows clearly the contrast between the present situation and the potential, as estimated. However, it must be stressed that such estimates are not based on a thorough knowledge of the standing biomass, life cycle, ecological behaviour and reaction to fishing pressure of each stock but on a knowledge of the biological productivity of the area of ocean studied, and of catches in apparently similar areas and, in some cases, on the estimated abundance of predators. The estimates, therefore, are subject to revision in the light of new biological research, resource surveys, exploratory fishing and commercial exploitation. Accurate assessments of the magnitude of the potential harvest requires detailed scientific investigation of the interaction of the various species. However, delay in making these studies should not be allowed to impede initial development of fisheries composed of unfamiliar species, but careful monitoring and research should be an integral part of any large-scale exploitation of them. This is necessary because sustainable yields in the long term depend on effective regulation of the fisheries.

Further, in looking at the present estimates of potential yield, it must be remembered that they are based, in part, on the capabilities of existing fishing technology. This, as is well known, has developed rapidly in the past 25 years and has largely contributed to the increased catch. If the technology continues to improve, as all signs indicate it will, more efficient harvesting of all stocks should ensue, including that of resources considered as unconventional at the present time.

A brief look at the estimates referred to in Table 1 will clarify the picture of harvesting prospects as we see them today, bearing in mind the reservations mentioned above about the estimates.

The first group in the Table is comprised of demersal fish, the species which usually have white, lean flesh and are at present mainly used for direct human consumption. While these form a very important source for commercial fishing and are in some areas fully exploited, even over-fished, there are under-exploited resources of them on the continental shelves. These, in the main, are found in the Southwest Atlantic (estimated catch available - 2 million tons a year); the Caribbean (several hundred thousand tons, widely dispersed); Indian Ocean (perhaps more than one million tons); and considerable quantities off Indonesia, the Philippines and the mainland of Southeast Asia, North America, Europe, the Southwest Pacific and the Southern Ocean.

In some cases, as the list given indicates, the new or under-exploited resources are remote from human consumption centres. For this reason - and perhaps because of prevailing weather conditions - their exploitation may require the use of fairly large and expensive vessels.

While the technology for harvesting these various resources is available there are problems of transport and distribution to be solved. Further, there is a need to identify the range of products to be processed from the catch for the various markets, especially for the inland markets in developing countries.

The second group, the small pelagic species, comprise stocks now mainly used for reduction to meal and oil. The technology of harvesting them for reduction purposes is well developed. However, some species of this group are widely used for direct human consumption in dried or salted form, mainly in tropical countries, usually fished by traditional methods. This form of processing would give rise to problems of transport and storage if there should be an attempt to develop new and more distant markets for these products. In view of this consideration, it is suggested that where large stocks of small pelagic species exist, exploitation of them for production of meal and oil would be an economic way to promote the development of a new fishery in the early stages of the enterprise. This would be followed up by producing such a product as fish protein concentrate type B, at least until new methods of processing make this approach unadvisable. This dried powder product has the advantage of requiring the same sort of low-cost intermediate technology as fish meal production. Such a product, of course, would have to be put through acceptability trials to determine if there is a market for it and the likely extent of the demand.

Incidentally, FAO as well as some national organizations have started such investigations for this and other fishery products.

Under-exploited stocks of small pelagic species have been located in the areas listed below and are estimated to yield the following quantities per year: Northeastern Pacific Ocean (2 million tons); Eastern Pacific (2 million tons); East Central Atlantic Ocean (1 million tons); Southeast Atlantic (1 million tons); Southwest Atlantic (1 to 2 million tons); the Arabian Sea (1 to 2 million tons); the Bay of Bengal and the Western Pacific (several million tons).

Mollusc resources are known to be plentiful and widespread. The best commerical opportunity with molluscs is to be found in aquaculture but there is also scope for increased gathering of the prolific wild stocks by countries with plentiful and cheap labour and a need to provide employment, and where the resource is in pollution-free water near to markets.

As the Table indicates, knowledge of cephalopod resources is not enough to enable reliable estimates to be made, hence the tentative suggestion of 10 to 100 million tons or more. It is believed that large unexploited squid resources are to be found over the continental shelves, at least seasonally. The big oceanic squids appear to constitute a vast resource but little is known about their behaviour pattern or how to detect and catch them. In view of the present limited market for squid as food and the extensive oceanic nature of the big squid resource, the required research and experimental fishing for it may not be forthcoming in the immediate future.

On the other hand, the technology for harvesting the smaller size species is well developed and further exploitation of the resource presents no problems in this respect. The difficulty is concerned with market acceptance. The main consumers of squid at present are the Mediterranean countries and Japan. What is needed to widen its appeal is product development to make it a generally accepted food.

Again, in the case of mesopelagic species, knowledge is insufficient to give a reliable estimate of the resource. The species are found in deep water off the continental shelves, often beyond the 200 mile limit. There is little experience of harvesting them. If they cannot be caught in sufficient concentrations by midwater trawls or other existing gear to make the effort economic, a suitable method will have to be developed. And if they are to be used for food rather than for reduction to meal and oil, work will have to be done to develop suitable processing methods and to make a product acceptable to the consumer. Furthermore, comparatively large vessels may be required for such fishing. As a way to reduce the cost of such operations, perhaps the vessels engaged in krill (Marine euphausiide) fishing in the Antarctic in summer could be used to fish the mesopelagic resources in other times of the year.

A considerable experimental and development effort has been made in recent years to exploit the vast krill resources. The various species of this crustacean are found in enormous numbers in high latitudes. For example, it is estimated that in 1939 the great whales consumed some 175 million tons of Antarctic krill (Euphausia superba). It is thought that the sustainable yearly yield of krill could be about 150 million tons, much of it to be harvested in the Scotia and Weddell seas and off the Antarctic Peninsula and South Georgia. But some of the stock is to be found in the even more remote areas of the Southern Ocean. This general remoteness of the resource, and other pertinent factors relative to its nature, impose special problems in its commercial exploitation. In particular, the circumstances have added immensely to the cost of investigation and experimental harvesting. Even the high catch rates achieved in recent expeditions do not necessarily indicate that this level can be maintained in commercial fishing. Then there is also the most important question of product development with a catch that spoils rapidly. So far, only small quantities, relatively speaking, are consumed in whole form (in Japan) while in Russia a paste type of krill product has been marketed and reportedly found acceptable by consumers. The krill catch, conceivably, could be processed to provide protein for incorporation in a variety of foods for the mass market and, of course, could be utilized for reduction to meal and oil.

Even allowing for progress made in harvesting and processing krill, pioneered largely by Japan and Russia and followed by a few other fishing countries such as Chile, the Federal Republic of Germany, Poland - and now Norway and the U.K. - development of products is still, in the main, in the experimental stage. In fact, it can be said that the whole concept of harvesting and processing krill is in its infancy and the situation calls for investment in very expensive high technology systems of harvesting and processing if the fishery is to be effectively and efficiently exploited. Indeed, the costs may be so high at the start as to require the creation of products which are acceptable in the markets of developed countries - a supply which, possibly, could result in the release of more cereals and pulses for the people of the developing countries. However, with research and development, krill products may become available for developing countries at prices they can afford.

The estimate of freshwater fish caught and used for food must necessarily be only roughly approximate in view of the vast numbers of people who catch and eat such fish, statistics for which can be little more than guesswork. However, there can be no doubt that both under-exploited and unexploited resources are to be found throughout the world, especially in the developing countries. An example is that of the Lakes Victoria and Tanganyika in Africa. It is believed that something like 500 000 tons of fish - mostly small species of various kinds - could be harvested each year from these waters. Generally speaking, the technology of harvesting fish from lakes, rivers, reservoirs and other areas of fresh water is well developed but is not as extensively used as it should be. The main problem in developing countries appears to be in processing the fish by low cost or intermediate technology (to keep the product cost low) and in developing other products acceptable to people who are unfamiliar with fish. The need is to provide products which can be stored and transported without damage so that they can be distributed to new and more distant markets. This is necessary because most of the fish available is produced in small quantities by a large number of fishermen and their families in communities scattered over extensive areas. Although the use of ice and containers, etc., can reduce losses substantially, there

are difficulties in providing such equipment and supplies in the circumstances, at least at an acceptable economic level. If the great potential of freshwater fisheries as a source of food is to be realized, improved but inexpensive low technology for processing, preserving, storing and transporting the fish and fish products needs to be introduced.

The production of aquaculture is put at some 6 million tons a year now and potentially at 20 to 40 million tons or more. The projected figures of possible future production are, of course, conjectural and should be regarded as no more than that. Many who are experts in aquaculture put the potential much higher. Indeed, it could be said that the production limits could be set by the extent of investment in this activity rather than by other factors.

Although cultivation of fish and shellfish has been practised for many centuries, it has been brought under systematic research and development planning only in recent times. This has already resulted in the introduction of new species of fish for cultivation and new techniques for the operation of what has become an extensive industry.

Indeed, large-scale enterprise, with a comparatively large capital outlay, is already a feature of modern aquaculture and is growing rapidly. At the other end of the scale is the small operator, ranging from the subsistence level upward. The small-scale fish farming operation lends itself to programmes for rural development but its success depends largely on the effectiveness of supporting services, such as those provided by extension workers, technical assistance and government-sponsored credit facilities.

Pilot scale operations to test the economic viability of different culture systems, demonstration of techniques, disease and pollution control research, processing and product development, etc., are all needed to help promote the expansion of aquaculture. Not only do they provide essential assistance to the small-scale fish farmers but are also of service and practical help to the bigger commercial enterprises.

Obviously, much remains to be done to improve production, especially in developing countries, as the varying yields of fish farms indicate. These range from a few hundred kilogrammes a year per hectare of ponds to as much as 20 tons - a difference which reflects the gap between the unimproved village farmer and the modern industrial aquaculturist. This gap could be narrowed, if not closed, through the use of present knowledge and techniques. An encouraging trend is the increasing investment in research and development, ranging from the introduction of new species for cultivation to the evolvement of new products.

The area under use by aquaculture is estimated to be upward of 4 million hectares, an area which, with the required investment could be substantially increased. Indeed, it is thought that, during the next three or four decades, this could be expanded tenfold. With the use of improved present day practices and species, such an expansion would increase production far beyond the quantities estimated at the present time.

The production potential could be further augmented through the new techniques which are being developed, such as the use of raceways and floating cages, and thermal effluent to increase breeding rates, to mention only three of many. Indeed, the research and experimentation now being conducted in various countries are bringing about changes in all aspects of aquaculture - breeding, feeding, disease control, the introduction of new species for cultivation, and so on. These factors are all conducive to the rapid expansion of aquaculture, given the required investment and other inputs.

Finally, relative to resources, there is the huge tonnage of wasted fish which should be utilized. Much of this, of course, is beyond economic recovery, being too widely scattered. But, for example, some wastage could be prevented in tropical and sub-tropical climates. Most of the losses there are due to inadequate processing and preserving, and to the prevalence of spoilage from bacteria, insects and vermin. It is estimated that millions of tons of fish are lost for these reasons, much of which could be saved through improved processing methods and better transport and storage.

Perhaps more accessible to remedial action is the vast amount of fish - estimated at more than 4 million tons a year - discarded at sea. This discarding is done for various reasons - fish thought to be unacceptable in local markets, or unprofitable to bring ashore, or difficult to handle, and so on. The shrimp fishery is notorious for discards - up to 20 times the weight of the shrimp caught! The profitable use of such discarded material still awaits discovery and development.

Another aspect of food loss through waste is in processing, such as filleting, which it is estimated recovers only some 40 percent of the fish instead of a possible 60 to 70 percent. However, machines are now in use to recover part of the lost flesh, which is being comminuted for use in a variety of manufactured foods, the skeleton and remaining flesh being used in making animal feeds.

3. TRADE AND MARKETS

Any consideration of the potential yield of fisheries must take into account the market for fishery products. A look at the present pattern of trade and available markets, therefore, should be useful as a guide to the future for fishery products, with a higher or lesser degree of normal flow as a result of world changes.

About a quarter of the present world catch is disposed of in the developing countries, mostly directly as food. These countries have about half the population of the world. Their share of the fish catch is about half of what it should be relative to the size of their population. In this respect the people of the centrally-planned economies are much better off since they total a third of the world's population and consume a quarter of the fishery catch. The remaining 50 percent of the catch is absorbed by the people of the developed countries, who total no more than about 20 percent of the world's population. Much of their consumption is, of course, in the form of fish meal and oil, which is used as an ingredient in animal feeding stuffs and for a number of industrial purposes.

The importance of meal and oil in the trade in fishery production is highlighted by the fact that around a third of the world catch is used to make these products. In 1970 some 35 percent of the catch was reduced to meal and oil. In 1974 the proportion was reduced to 29 percent, chiefly because of the failure of the anchoveta catch off Peru and Chile. Whatever the future may hold regarding the extent to which the world catch is so used to produce meal and oil, the fact will remain that this industrial processing of marine resources will form a major market for the catch. As already indicated, for example, exploitation of unexploited or under-exploited resources may, in the early stages of development of such fisheries, be most profitably used by the fishmeal industry.

The fact that much of the catch which is now used for reduction comes from the waters of the developing countries points to the need to change this pattern. Some of the catch could be used in the developing countries as food for their people or as feeding stuff for animals. And if their fishery resources are to be used for providing raw material for manufacture of meal and oil, they might as well get into the business themselves. By so doing they could provide fishmeal and oil, both in steady demand, for export, thereby building up an export trade and acquiring much-needed foreign exchange. At the same time such an undertaking could provide the funds, experience and training of manpower on which gradually to start to build a modern fishing industry. In the meanwhile, control over the catch for reduction will offer opportunities for utilization of some part of it for direct consumption by the population or for feeding stuff for their cattle and other animals.

This aspect of the present state of trade, and what can evolve in the changing circumstances, is of special significance to developing countries for several reasons. One important consideration is the wastage of local catches, particularly in developing countries in tropical and semi-tropical climates. Such wastage, due to autolysis, bacterial action, oxidation and insects and other vermin, etc., is said to be as much as 50 percent of the catch in some areas. Whatever the actual figure may be, a large part of the catch in such

countries is spoiled, probably amounting to some millions of tons a year. There is no agreed reliable figure. Then, in addition to such spoilage, there is loss of nutritional value through partial degradation of the proteins in some products, such as that of fermented fish in Southeast Asia.

Whatever the trade opportunities that can be developed from the present situation vis-a-vis the developing countries, the value of resources of crustaceans and such fish as tunas is undeniable. Indeed, such is the world market for the products of these fisheries that many commercial arrangements have already been entered into by the industry and developing countries. Although the quantity of the crustacean catch may be fractional of the total landings of a country, the market value is high. Here again, a developing country can use a fishery resource to earn foreign exchange and as an aid towards building up its fishery industries.

A point worth stressing here is that the quality of product is becoming of greater importance, especially in the export markets of the developed countries. Thus, quality control is now a key to market development and demands improved handling and processing, with emphasis on hygiene. Such a situation, of course, opens up opportunities for technological and business cooperation between the fishing industries of developed countries and the developing countries for the supply of products with wide market appeal. Further, the introduction of high levels of quality control will, in the long term, infiltrate into local trade in developing countries and influence the markets there.

4. INVESTMENT ASPECTS

Perhaps, as an introduction to consideration of investment aspects, it would be useful to provide a summary of the traditionally accepted advantages and disadvantages related to investment in fisheries.

Some of the advantages are considered to be:

(a) Fish are an excellent source of animal protein and certain minerals and vitamins, are with few exceptions non-poisonous, are not infected with pathogenes, and form an easily digested food.

(b) In view of the great need for increased supplies of protein-rich food, fisheries provide a means for rapid increase in supply; fisheries produce 3 to 30 times as much animal protein per unit input of energy as does intensified western-style agriculture.

(c) Aquaculture can make use of ponds, lagoons, inlets and other stretches of water not otherwise used for food production; the fish farmed are more efficient convertors of supplementary feeds than are land animals, often consume less sweet water, and make good use of organic wastes from agriculture.

(d) Mollusc culture provides a profitable way to make use of the ocean's biological productivity.

(e) Modest total outlay of funds, even for such capital investment works as harbour construction for which local materials can largely be used and construction undertaken by stages without irrevocable commitment of funds and other inputs.

(f) Such ancillary industries as boat-building, net making, engine building, etc., can be established in the area concerned, with many of the required materials available locally or within easy reach.

Some of the chief disadvantages are said to be:

(1) The inherent risks at sea to men and vessels.

(2) The lack of property rights in fisheries as security for loans - a situation that is changing with the introduction of the extension of national sovereignty over fishing limits.

(3) The danger of free entry to a fishery leading to over-exploitation - a situation again likely to change with the introduction of the new fishing limits.

(4) The perishable nature of fish.

(5) Competition from other foodstuffs and products.

(6) Cost and effort required to raise new species of fish and to produce from them products acceptable to the consumer and to extend markets in areas where fish and fishery products are unfamiliar.

(7) The lack or inadequacy of roads and distribution systems.

(8) The lack of technical and economic information about resources needed for efficient harvesting and processing, etc.

(9) The lack of skilled manpower in all sectors in many developing countries for control and regulation of fisheries, food technology, engineering, shipbuilding, other ancillary industries and extension services, and for commercial operation and management of fishery enterprises, and so on.

(10) The lack of spare parts for ships, engines and machinery in general, afloat and ashore, to keep them in working order.

(11) The poor status of the fishing industry and fishermen in many developing countries, due to their inability to draw attention to their plight and failure of governments to provide support required to build up and promote the industry.

(12) Another serious aspect of government neglect is the lack of legal protection for fisheries to help promote development of the industry (including aquaculture).

The foregoing lists do no exhaust the pros and cons of fisheries from an investment point of view. In any case, such lists, in order to be realistic, would have to be made up for each country, perhaps for each fishery area of each country, and modified in the light of local conditions. However, they serve in this form as a general guide to the situation but call for further comment on various of the aspects and considerations involved, particularly as many recent developments tend to offset or at least reduce the traditional disadvantages.

It is generally thought that the risk element in fisheries is high for an investor while the returns on the investment are thought to be low. But there are examples throughout the world of the fishing industry being profitably conducted for generations past, mostly under more difficult circumstances than faced today. It is true, of course, that fishermen at sea are still to some extent at the mercy of the elements, especially in those regions notorious for bad weather. And it is true that the investors and managers ashore have limited control over their fleets, having to rely to a large extent on the skill, courage and resourcefulness of their skippers and crews. Another adverse factor, of course, is that the fishermen themselves have no effective control over the movement, behaviour and living conditions of the resources they fish, except to the extent that regulations governing a fishery are imposed and observed. But the fishermen are these days better equipped than ever before, possessing sophisticated electronic and other mechanisms to

supplement their hard-earned skills and experience, and those add to their safety and that of their vessel. This being the case, the risk of the investor today is less than that of any of his forerunners throughout the age-long history of fisheries.

Commercially speaking, profitability in fishing operations is more controlled today than heretofore. The "free for all" days of fishing enterprises have, generally speaking, passed because of the control and regulation over fisheries being increasingly exercised by all coastal states so far as their own waters are concerned and by governments in concert so far as international resources are concerned. Such measures provide some assurance of continued worthwhile catches in future years. There are good reasons, therefore, for hoping that profitability will be better assured for the future.

Perhaps one of the best guarantees for profitable operation of fishing as an industry is the diversification in fishery products. The success in product development, particularly in recent decades, has led to a multiplication of the ways in which fish and fishery products are now presented, making them available in markets throughout the world. This versatility in products has extended the acceptability of fish as a food far beyond the traditional limits of the past. Indeed, the main requirement now is to extend this progress in product development, distribution and marketing to the developing countries.

While investment in fishing has traditionally been largely a commercial undertaking, the situation has changed considerably in the past 25 years or so. This is due to a number of factors, the dominant ones in many countries of the so-called "Third World" being the socio-economic role now played by most of their governments, the importance of fish as food, and the lack of funds in sufficient volume for investment in fisheries by commercial and financial sources. There is also the impact made on the industrial scene by those countries dominated by central economic planning. The development of their fishing industry is part and parcel of their industrial development programme.

Even in the western developed countries where commercial interests remain the chief investors in industry, the inevitable public investment in the infrastructure, such as harbours, roads, and the supply of power and other services, has brought the governments more and more into the fisheries situation and to intervention in the industry. Furthermore, there has been a growing trend towards government assistance in the form of subsidies, tax concessions, grants, loans, generic advertising, support for ancillary industries, such as shipbuilding, and investment in training, research and technical development - the list is long and varies from country to country. Such benefits from government action are enjoyed not only by fisheries but also by many other industries. And so far as fisheries are concerned, it is difficult to assess the full impact of government actions and intervention or to make a clear distinction between public and private involvement.

While the value of say, subsidies or grants and so on may be simple enough to determine, the same ease of measurement does not apply to, for example, scientific and technical research. Almost all scientific research and much of technological development are undertaken by governments for a number of reasons, among them being the fact that the costs and organization required are beyond the reach of most fishing enterprises, except for a few of the largest in the world. In any case, fisheries embrace a very wide range of sciences and technologies which are constantly changing and developing - changes that are often involved at government level in international problems, including regulations and controls which have to be negotiated between governments.

Again, to take another and more mundane example, government technologists often have to take experimental work to the stage of full-scale trials before commercial fishing interests feel justified in accepting the innovation and investing in it.

Market economies provide a further example. Even in countries which are noted for commercial enterprise, the initial investment for expanding food industries, for instance, may have to be stimulated by injection of government sponsored funds on favourable terms to bring about the required increase in production at the rate, and in the time, desired.

Motivation for investment and expansion, of course, is of critical importance. For instance, in many developing countries - and often in those with centrally-planned economies - the chief motivation is to produce more food without reference to the profitability of the operation. The purpose of such investment, therefore, differs from that motivating the commercial investor. Such food production enterprises are usually State-run through the appropriate governmental agencies, although private enterprises, domestic or foreign, may participate. In such arrangements their "investment" is usually safeguarded by agreement with the government and the extent of their involvement may range from participation at every stage and in every aspect to participation in selected sectors or perhaps limited to the intricacies of, for example, the export marketing of products.

Incidentally, it should be noted that the motivation of fisheries development to provide increased supplies of food does not, in itself, rule out profitable fishing operations. Indeed, given the favourable factors of resources abundance, adequate investment and supporting services, and available markets, such a development scheme may become a very profitable enterprise of great commercial value.

Investment in the form of technical assistance and the supply of vessels, machinery, gear, equipment, training of manpower in the required skills, and so on, is an accepted international contribution, including funds provided by the international Banks. As Table 2 shows, official development assistance is available on quite a substantial scale, as indicated by the U.S.$ 144.9 million provided for fisheries in 1974 by various bilateral assistance bodies, the UN system, governments and the development banks.

As the foregoing observations regarding investment indicate, the development of fisheries in significant terms relative to world or regional or, often, national food supplies, depends largely on the initiative of governments, particularly in the case of developing countries. And even where countries have resources of crustaceans, tunas and others in strong demand in world markets, and where commercial operators will be ready to make the required investment to exploit these resources, governments will certainly be involved in the control and regulation of the fisheries to ensure that the exploitation is of benefit to the economies of their countries, and, probably, will participate in the investment and in the organization, management and operation of any such enterprise whether the commercial element is domestic or foreign.

This situation is understandable, especially in relation to developing countries, in view of the importance of fisheries as a source of protein-rich food the possibility of earning much needed foreign exchange, the opportunity to add to the country's industrial strength and skill, and the creation of employment not only in the fisheries sector but in a wide range of ancillary industries, such as shipbuilding and factories to make engines and other machinery, gear and equipment, and the food processing sector. There is also the fact already pointed out that the scale of investment required for a serious development programme for fisheries is too much for the normal range of commercial companies to risk even if they have the funds available and the prospects are highly promising for profitable operation.

While the cost in manpower and funds for the development of methods of harvesting might appear at first sight to be the major burden in the development of fisheries, the cost for the development of handling and processing the fish and other raw materials, and of transporting, storing, distributing and marketing the products is likely to be the greater. This applies both in the case of dealing with unfamiliar species and products where fish is an accepted food and in dealing with fishery products in general where fish is not an accepted food. This is an aspect which is not always fully recognized by governments, especially those, such as in developing countries, which have less experience in product development and distribution and marketing.

The higher cost in this sector arises because of the lengthy process and the variety of manpower required to establish acceptance of the products in both cases. For example, new species and new products are not quickly accepted even in traditional fish consuming communities. Further, there has to be allowance made for the time taken to adapt existing processes and methods to suit the characteristics of the new raw material as well as for meeting the requirements of local consumer preferences. The procedure may be more protracted in areas where fishery products are unfamiliar or, worse still, where there is a prejudice against them.

The problems in both cases are likely to start from the handling of the catch when it is brought aboard the fishing boat until its final sale. In some instances, of course, traditional processing methods can be modified or even upgraded without too much difficulty but in others virtually new processes and new products will have to be developed. And while the general principles of the various processes commonly used are known, suitable adaptation of them may be a cause for delay.

Whatever product is offered to the consumer - even if no more than an unfamiliar type of fish, fresh or frozen - consumer-acceptance trials on a pilot scale are necessary, as are storage trials and tests of the distribution and marketing system. After these initial trials the more promising of the products then have to be subjected to marketing trials on a scale sufficient to provide assurance of acceptance by the consumer. These trials must provide the reliable information required for making the decision to invest or not.

It goes without saying that such trials as those described are only organized as and when the supply of raw material on an economic scale is assured. This can be ascertained in the course of exploratory fishing. The assessment of the market potential and all the required distribution, storage and marketing arrangements should have been completed before fishing at a commercial level begins, so that there is no loss or delay in marketing the catch from the day of the first landings.

In view of the special problems concerned with product development, distribution and marketing, many governments draw on the expertise of commercial companies through joint venture or similar arrangements. This may involve cooperation with domestic or foreign concerns in all aspects of the development of a country's fisheries or may be limited to the product development, distribution and marketing sector.

Perhaps mention should be made here that participation in fisheries by most, if not all, governments has greatly increased in the past 25 years. During this time a feature has been the introduction in some national fishing fleets of very large fishing and support vessels capable of operating in the most distant areas of the high seas. This development is part of a general tendency for consumer countries to acquire or extend their own capability for harvesting favoured fishery resources wherever available in any part of the world. The extension of national fishery limits will obviously have an effect on this situation and, presumably, in the long run even the most distant resources open to general exploitation will come under international control to maintain their maximum sustainable yield. These changes and changing conditions are likely to affect the composition of future fishing fleets, especially as the productivity of long-range vessels in terms of capital outlay, maintenance, manpower, fuel and other inputs is less than that of much smaller deep sea vessels. The latter are equally up-to-date in technology and have the advantage of being based on harbours in coastal states adjacent to the fishing grounds. The extension of national fishing limits will favour the smaller vessels and it may be assumed that by the end of the century most of the fishery resources on or around the continental shelves will be harvested by vessels based on the coastal states controlling the area concerned. The extent to which such fisheries are harvested by domestic fishery enterprises or by joint ventures with foreign fishery interests will be subject to negotiation and control by the governments concerned.

5. PRE-INVESTMENT ACTION REQUIRED

As the references to the present situation and prospects for fisheries development indicate, the opportunity exists for a substantial "break through" to double the total world catch. The potential harvest is available and the technology exists to reap it. What are needed are the government policies and programmes directed to this end, and the investment of funds and other inputs on the scale required.

But before looking into these requirements, there is need to indicate the pre-investment action that must be taken to clear the way for the planned development to proceed at the pace determined by the total investment of funds and other inputs. In summary, the pre-investment action required calls for:

(1) Review of existing programmes for utilizing the latent resources of fisheries (including aquaculture) for food for developing countries, such as research and surveys, technological work on harvesting gear and methods, and market investigation and product development.

(2) Preparation for the better control and regulation of fisheries to meet the requirements of the envisaged development programme.

(3) Preparation of a comprehensive action programme leading to the investment stage of development. Such a preparation programme should determine the extent and duration of research and exploratory fishing, marketing trials, etc., required, the training schemes to provide the skilled labour, and the arrangements needed to meet envisaged demands for facilities and services and to make provision for the required inputs, including finance.

Such preparatory action, leading up to the proposed investment programme, should be of the greatest value to the planners, not only in getting necessary operations under way but in indicating how some requirements may be met. For example, the period required to train manpower needed for the development programme could result in years of delay. Therefore, the reasonable thing to do would be to call in scientific and technical assistance from abroad. The pre-investment preparatory action should indicate not only the extent of this requirement but where such assistance could be obtained, under what conditions and arrangements and at what cost. A review of this matter would call for a clear statement relative to the assistance available through the UN and the international system generally, through bilateral assistance agencies and through other government sources in technically developed countries and through the commercial world of fisheries.

A review of available financial assistance, both domestic and foreign, would be of the greatest value to those engaged in preparing the investment programme. This would help them in determining the total amount of foreign funds likely to be available, the amount from each source and the conditions under which the funds would be made available. For instance, while the most favourable terms may be offered by the international development banks and most of the required funds may be obtained from them, the most desirable arrangement may well prove to be the use of a variety of sources of aid, including commercial agreements which, in addition to any financial contribution, may involve many kinds of technical assistance including such essential aspects as product development, market research and distribution and marketing.

Pre-investment action should also provide a guide to the investment programme planners of the cost of establishing the new enterprise. This means not only the investment planned but the whole range of everyday expenses that can, and often do, add up to a formidable total before an investment programme gets under way.

As fisheries development on the scale envisaged can only take place on the initiative and with the active support of the government of the country concerned, pre-investment action should spell out for government consideration those policies that need to be adopted and followed up in support of the investment programme.

Reference has already been made in item 2 of this section (page 12) to the need for better control and regulation of fisheries. A government, in accepting the need of this, will have to enact the necessary legislation to enforce such control and to provide a law enforcement service for this purpose. This is only one aspect of a very complicated situation which will inevitably develop once a government is committed by policy and action to a fisheries development programme of the kind envisaged. The extent of such commitment should be made clear to the governmental authorities at the pre-investment stage so as to give them time enough to take the decisions and actions required for the government to play its part in the development programme.

The time, cost and complexity of pre-investment action will vary, of course, from country to country as well as from case to case. The development of a fishery in nearby waters for the local market, for example, presents a simpler and less costly investment demand and development programme than does the development of a more distant fishery yielding a harvest that needs to be processed for international trade. The investigations in this preliminary stage may reveal that a proposed development would not be viable commercially. Indeed, the decision may be reached that it would not be worthwhile as a source of food or for any other purpose. One of the objects of pre-investment activities is to establish the viability of the proposed development to determine whether or not to proceed. Great losses have been incurred in all kinds of development programmes through lack of thorough pre-investment investigations. This has frequently happened in fields other than fisheries where assessment of viability of a proposal is easier to make - yet tens of millions of dollars have been wasted by the time such projects have been abandoned. Particular care, therefore, should be taken in the pre-investment investigations of any fisheries programme because of the inherent difficulties in this field.

6. ESTIMATED INVESTMENT REQUIREMENTS

The Tables contained in this paper show the general situation regarding the potential of fisheries and the estimated investment requirements for the various increased levels of production envisaged. Thus, Table 1 reflects present estimates as to the potential yield of world fisheries, a tentative total ranging from 240 to 455 million tons a year. It should be noted that even the lower estimate is more than three times the present total harvest.

Tables 3 and 4 deal respectively with first cost and production performance of various types of vessels and assumptions regarding costs of shore installations.

Tables 5 and 6 are concerned with the main volumes of investment required for certain levels of increased production. Table 5 gives a breakdown of investment requirements relative to the target of a total harvest of 130 million tons a year - an investment in the region of U.S.$ 30 000 million, not including such important items as resource and market investigations, technical development, distribution systems, etc. Table 6 summarizes the investment requirements (1976 prices) for higher total production:

150 million tons - U.S.$ 41 000
175 million tons - U.S.$ 56 000
225 million tons - U.S.$ 87 000

Table 2, which records the estimated official development assistance provided for world fisheries in 1974, shows the sources of funds, etc., and serves to indicate the need in future for more generous contributions from these and other sources.

While the Tables present the statistical information succinctly, some further comment on the situation is needed:

The estimates, inevitably, are incomplete because some requirements for fisheries development cannot be assessed in sufficient detail to enable a reliable estimate to be made. Items not included in the estimates are: preparatory expenditure, such as exploratory fishing, technical development, market investigations and test marketing, technical assistance, establishing or strengthening the fishery services and other organizational framework (such as inspection services, ship repair and ancillary services) pump-priming expenditure required in establishing commercial enterprises, the costs of building up or expanding the distribution system, and so on. As can be readily understood, no general guide to the funds and other inputs required for such items as these can be determined. Estimates for each item have to be made in the light of the local situation.

An example is the case of a distribution system. The road and railway and other transport networks vary greatly from country to country and from area to area within a country. So do the storage and distribution facilities, and where these exist they may not be suitable for handling fishery products. In some countries, fishery products may be distributed by aeroplane, refrigerated railway trucks and ships as well as on foot or by hand-cart or by bicycle,motor-bike, or other means. The products may be sold at the roadside or on the beach or by hawkers or in general stores and specialized shops or even from refrigerated cabinets in self-service stores and supermarkets. And the products are often sold in bulk to institutional and industrial canteens, to catering chains, and to hotels and restaurants. In view of the complexity and variety of distribution systems and their various stages of development, the cost of expanding any system to meet new demands must be determined locally. However, it should be added that as profits are more certain in the distribution and retailing of products than in the catching and processing of fish, etc., private enterprise is likely to move in rapidly once pilot demonstrations show there is a market demand for the products.

A continuing cost which cannot be estimated in a general way is that of research and development. Such services are required to monitor the state of the resources and to measure the effects of harvesting so as to provide a reliable guide in drawing up the regulatory measures needed to manage the resources. There is also the need for technical research and development to improve and make more efficient the vessels, gear, equipment, machinery and processing and marketing methods employed. The cost of such research in some countries amounts to U.S.$ 5.00 or more per ton of fish harvested - a figure which indicates roughly the likely cost of this continuing but necessary operation.

Another indeterminate cost is the subsidy which a government may be required to provide to support fishery industries. In Western European countries such support in bad years may amount to U.S.$ 10.00 per ton of fish caught. This, it should be stressed, is support for established industries. It is all the more likely, therefore, that newly established industries will not be commercially viable and will need this kind of financial support, probably for many years until fishing experience provides a reliable basis for regulation of fishing, thereby, hopefully, stabilizing the catch.

The financial support referred to above is usually provided from a government's revenue and is, in effect, a cost for subsidising essential food industries and services.

It will be seen that there are two references to harbour costs - one of an investment requirement of U.S.$ 5 200 million in Table 5 for the 130 million tons target, and a general guide in Table 4 to the cost of those "additional port installations" usually regarded as a charge on fishing operations. This is assumed to be, on average, one quarter of the cost of the vessels required to achieve the increased production specified. However, if the cost also includes roads, water supply, power, housing, etc., - not usually regarded as a direct charge on a fishery - it will amount to about that of the cost of vessels needed to reach the increased production target.

With regard to the estimate of the vessels required, allowance must be made for the differences in costs of materials and construction from country to country. The costs given in Table 5 of U.S.$ 30 100 million are believed to be average, as are the performance figures for the vessels. Where the range in vessel size and tonnage is extensive, an average has been taken, such as 5 000 tons for ocean-going factory ships which, in fact, vary from 3 000 to 12 000 tons displacement.

The vessel performance figures are for present fisheries and do not refer to harvesting unconventional species. While some allowance could have been made for the harvesting of more distant and, perhaps, unconventional resources, it was thought that normal technical progress between now and 2000 will be sufficient to offset this factor.

Again, in the estimates for processing plant, assumptions have been made about how much of the additional catch will be processed by high, intermediate and low level technology. This takes into account the investment required for utilizing for direct human consumption some of the catch now reduced to meal and oil. The three levels of technology are roughly defined as: high - quick freezing and low temperature storage, accelerated freeze drying and processes such as are used to produce fish protein concentrate type A and krill protein coagulates; intermediate - fish meal and oil production, FPC type B and the estimated 12 million tons of small pelagic fish now processed by intermediate technology; and low - simple drying, smoking, salting, pickling and fermenting processes.

The estimated investment requirements for key manpower include sea-going officers in vessels and extension workers. Managers, administrators, scientists, technicians and key personnel in ancillary industries, such as ship repairing and marine engineering, are not included.

The estimates for the investment required for aquaculture must, of course, be tentative because of the varied nature and condition of the industry. For instance, it is roughly estimated that about one-fortieth of the projected increased production of 5 million tons may be high valued species costing around U.S.$ 750 a ton to produce, while the remainder may cost only U.S.$ 150 a ton. The total investment estimated for 5 million tons increase has been put at about U.S.$ 385 million, including the cost of the land. Such increased production would also call for about 9 000 technicians, 1 000 aquaculturists and 100 high level specialists, a body of key personnel which would take about ten years in all to train. There would also be need for about U.S.$ 60 million to strengthen research, training and information services.

Relative to this investment situation, it should be pointed out that the UNDP/FAO Aquaculture Development and Coordination Programme has organized regional workshops in Africa, Asia and Latin America, with the result that 10 year development plans for fish farming have been prepared for 32 developing countries. The combined target of these plans for increased production is 5 million tons. These countries require funds to help them procure land and construct ponds and provide various fish culture facilities, including those for research, training and extension services. They also need to produce and distribute fish seed and feed, fertilizers and pesticides, and to set up a credit scheme. In view of the groundwork which has been and is being done, the prospects for investment in the development of aquaculture appear to be promising.

After making the various adjustments and assumptions stated in the foregoing text, it is estimated that an investment of some U.S.$ 30 000 million (at 1976 prices) is required to raise the total world catch from its present level of 70 million tons a year to 130 million tons by 2000. This means that if all the preparatory work is completed by 1980 and the full-scale drive to achieve the target is then launched, an investment of some U.S.$ 1 500 million a year will be required for the following 20 years. While this is a substantial sum, it is still less than a tenth of the estimated investment (said to amount to some U.S.$ 16 000 million a year) required to stimulate agricultural production in developing countries.

These estimates do not include the cost of replacement of present or proposed new vessels, shore installations and so on. For accounting purposes, vessels are sometimes "written off" over a period of ten to fifteen years although their average useful life is about twenty years. If the required investment begins in the near future, therefore, some of the new vessels will need to be replaced by or around the end of the century, a cost for which provision will have to be made to ensure continuity in the production drive.

Similarly, provision will have to be made for the maintenance - and extension as required - of the wide range of shore installations, etc.

7. CONCLUSIONS

This paper has attempted to present in broad terms the potential of fisheries as an important source of animal protein food supply, given the required investment and inputs. In so doing, it has dealt briefly with the present demand and supply situation, the estimated future demand, the potential resources, both traditional and unconventional, the pattern of trade in fish and fishery products, the present and possible world markets, the various investment aspects to be considered, etc. Reference has been made to the many problems which inevitably must be encountered in seeking to promote the development of fisheries, and particular attention has been drawn to the preparatory actions and work which must be done if a fisheries development effort on a world-wide scale is to be successfully undertaken through the period of 1980–2000.

One fact of over-riding significance which stands out is that a huge potential for fishery development exists. Even though detailed information on many of the aspects of that potential is limited, sufficient is known to be sure that world resources are rich enough to supply several times the present catch of 70 million tons of fish per year. As the estimates of the potential yield range upward from 240 to more than 455 million tons a year, the proposal made in this paper to raise the catch in the first instance to some 130 million tons is modest.

However, whether or not such a catch is achieved depends on man's response to this challenge which invites him to develop the potential of the world's aquatic resources. The challenge, in effect, is directed to governments throughout the world, especially to those of developing countries, and calls on them to adopt the policies and take the actions required to promote the exploitation of all aquatic resources in such a way as to harvest their maximum sustainable yield.

This paper has also drawn attention to another significant fact which sometimes tends to be overlooked - that man has the technology and the other skills needed to double, perhaps to treble or quadruple, the present food catch. All the known obstacles or deterrents to such development, most of which have been referred to in this paper, can be overcome given the determination of all those concerned to exploit the potential and to provide the complete range of inputs required for this purpose. And, again, it must be stressed that all the required inputs can be made available. Even the big investment funds required - U.S.$ 1 500 million a year for 20 years to achieve a catch of 130 million tons a year - do not amount to a formidable total relative to the food supply to be gained. The work to be done to achieve the required production, as indicated by the lists of the pre-investment actions to be undertaken, and the priorities and programmes to be established, is clear enough. As has been already stressed, the need is to set in motion the development operation by the adoption of constructive fishery policies and programmes by the governments concerned, especially those of the developing countries where the need now, and in the foreseeable future, is to increase substantially the supply of animal protein food for the masses of their people.

As has already been emphasized, while governments must be responsible for taking the initiative in such development effort, the help of all concerned should be enlisted. This includes not only the assistance of governments of technically advanced countries to those of developing countries, but financial, technical and other assistance by the UN system, the international banks and bilateral agencies, and, of course, private industry in fisheries.

It should be mentioned here that FAO has already done much to promote fisheries development, especially in developing countries. The Organization has, jointly with the United Nations Development Programme and other UN specialized agencies, as well as with many international aid agencies and other assistance bodies, undertaken fishery development projects and programmes through more than 20 years past. Now, given the support of Member Governments, FAO is geared to an increasing effort to promote the development of fisheries throughout the world.

But, as has been stressed time and again, the initiative and the provision of investment funds and other inputs for the world-wide drive to develop the fisheries potential, must come from the governments, especially those in developing countries. Given that initiative, fisheries can be established as a major source in future of supply of animal protein food for mankind.

Table 1

Present Utilization and Potential of Fishery Resources[a/]
(Annual yields in million t – rounded figures)

Resource	Used for food	Fish meal etc.[b/]	Discards at sea	Post-harvest losses	Additional potential catch[c/]
Marine, demersal[d/]	20	6	4-6[g/]		15
Marine, small pelagic[e/]	12	11			25-30[e/]
Marine, other fishes[f/]	3				2
Marine cephalopods	1				10 to 100+
Marine mesopelagic species	–				100(?)
Marine euphausiids (krill)	–				50 to 150+
Other crustaceans	2				1
Other molluscs	3				Very large[h/]
Freshwater species	11				5
Totals	52	17	4-6[g/]	5 to 6+	230 to 445+
Total used at present	69		Total potential		240 to 455+

a/ Based on 1974 production figures and estimates of potential available to FAO in 1976. Including aquaculture, which yields approximately 6 million tons per year; excluding "other aquatic products".

b/ Excludes processing offal used for reduction purposes (about 5 million tons).

c/ Estimates of available surplus, plus additional production that could be obtained over present catches through sound management.

d/ Includes all species unidentified.

e/ Includes capelin; the higher figure relates to a recovered stock of anchoveta in the South Eastern Pacific.

f/ Mainly large pelagic fish, e.g. tunas.

g/ Includes 3 to 4 million tons from shrimp fisheries.

h/ Mainly through culture, a potentially very large figure.

Table 2

Fisheries Sector: Estimated Official Development Assistance, 1974

(Source: FAO/COFI/75/8)

Source	U.S.$ million
Direct bilateral assistance[a]	Approx. 50.0
Bilateral assistance channelled through multilateral agencies[b]	2.0
UNDP/FAO executed assistance	9.5
Development banks	83.4[c]
Total:	144.9

a/ Including small but unquantifiable aid from non-governmental organizations, e.g., MISEROR, OXFAM, etc.

b/ Including official and non-governmental assistance

c/ Loans for fisheries approved during the year

Table 3

First Cost (1976) and Production Performance of Various Vessel Types

Fishery	Vessel size m LOA or GRT	Cost U.S.$ 000	Catch/vessel t/year
Coastal, freshwater and marine	9-12 m	17	8
Inshore freshwater and marine	13-15 m	45	200
Offshore (marine demersal, including cephalopods, also tunas)	21-30 m	250	600
Offshore, small pelagic	21-30 m	250	1 500
Krill and mesopelagic	3-12 000 t	8 000[a]	20 000
Oceanic squid	6-700 t	2 000?	3 000?
Aquaculture, high cost species	-	0.4	1
Aquaculture, low cost species	-	0.07	1

a/ 8 000 t vessel

Table 4

Assumptions Regarding Costs of Shore Installations

Type of Installation	Capital Cost, U.S.$ per t/year input of raw fish
Fishmeal plant, sophisticated design, also FPC Type B	(20 to 60) 40
Other drying systems, low and intermediate technology	(4 to 60) 20
Other forms of processing, including sophisticated drying	100
Processing of cultivated supplies	say 50
Additional port installations conventionally regarded as a charge on fisheries operations	Assumed to average one quarter of the cost of the associated vessels for increased production up to 130 million t/year at half the cost of vessels for any additional increase.

Table 5

Estimated Investment Required to Increase Fish Production to 130 million t/year, 1976 prices

Includes training of key manpower, does not include investigation of resources and markets, or development of means of production, products and markets. Does not include distribution systems

Item	Cost U.S.$ million
Resource and market investigations, technical development, etc.	not included
Vessels	20 100
Harbour installations	5 200
Aquaculture installations, etc. including molluscs	1 200
Processing plant including plant to process 10 million t/year at present utilized as fish meal	2 900
Investment to save discards and post harvest losses (other than reduced to fish meal)	100
Training of key manpower	800
Distribution systems	not included
Total excluding development costs and distribution systems	30 000

Table 6

Estimated Capital Investment (1976 prices) to Meet Requirements for Increased Production related to Various Levels of Demand, excluding Development Costs and Costs of Distribution Systems; including Costs of Training Key Manpower

Total production millions t/year	130	150	175	225
Additional investment U.S.$. millions 1976 prices	30 000	41 000	56 000	87 000